SILAGE AND SILO CONSTRUCTION FOR THE MARITIME PROVINCES

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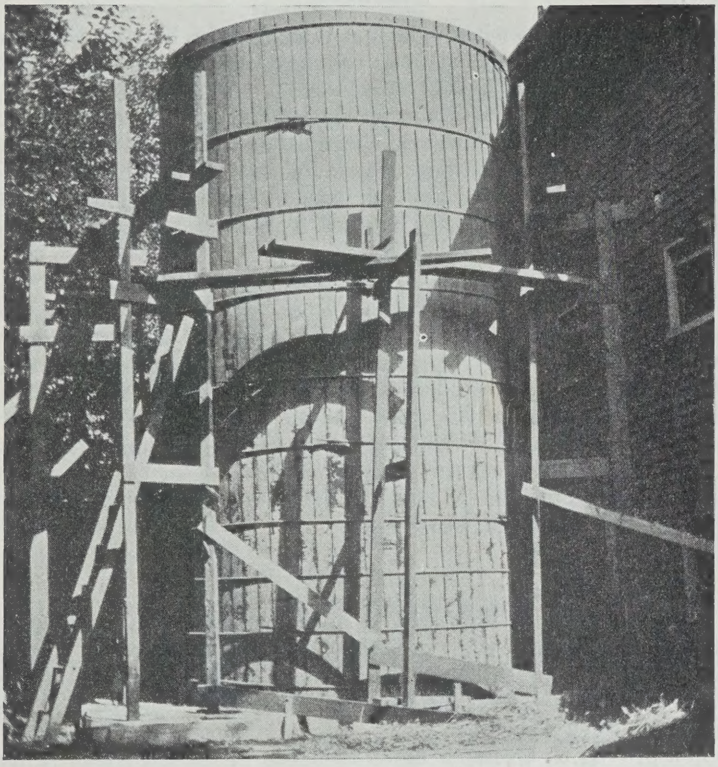

A STAVE SILO
Charlottetown Experimental Station

Silage and Silo Construction for the Maritime Provinces

INTRODUCTION

The greatest problem in the Maritime Provinces to-day is the reduction of production costs. Competition in most lines of production is so keen that it is necessary to find the simplest and best method of saving and utilizing all farm crops.

Feeding forage crops to live stock is the most economical way of marketing them. In mixed farming, which is most generally followed in the provinces by the sea, there are many unsaleable farm products graded out when potatoes, vegetables and grains are properly sorted and graded for market. These should be manufactured at home into finished products that are in demand. Live stock and poultry will do this most efficiently if the right sorts are bred and properly fed. *In feeding certain classes of live stock a cheap means of providing succulent roughages is necessary to success.*

We have depended largely upon turnips and other roots in the Maritime Provinces in the past for these essential succulent roughages. The club-root disease has seriously affected our turnip crop. The high cost of labour for thinning and weeding the roots has greatly increased the cost of production so that we must look for other means of securing cheap, succulent fodder.

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SILAGE

The silo will provide such roughage. When fodder has been fermented in an air-tight container and preserved until required we call it silage. While undergoing this necessary fermentation process, the fodder loses some of its nutriment and is not equal to June grass for either the production of milk or gains in weight of live stock. It is, however, the most economical means yet found for saving the nutriment value of our coarse fodders. All such fodders gradually lose their value in time when kept in any other way. They are frequently destroyed by vermin and seriously injured by fungus diseases if stored, except in a silo.

COST OF STORAGE

A barn built to accommodate the same tonnage of coarse fodder would cost more than four times as much as it would cost to store the same tonnage in a silo. Surplus fodder can be held safely for a much longer period of time, with no appreciable extra cost until needed. About fifty tons of silage can be stored in a silo 13 feet by 20 feet, which can be built for less than $250 anywhere in the east. Allowing 10 per cent depreciation, the cost of storage would be only 50 cents per ton per annum. Silage has been held in good condition for many years and used to advantage when needed.

SILAGE CROPS

The main silage crops that have been grown successfully in the Maritime Provinces are: Corn, oats, peas and vetches, and sunflowers. Crops that are used occasionally are, sweet clover, red clover, oats and various mixed grains. Other fodder plants and weeds can often be used to advantage in a silo when of little or no value otherwise.

Corn has proved to be much more valuable in these eastern provinces than the public generally give it credit for. Everyone remembers a poor corn year or a failure, forgetting the many, many years that corn has provided the necessary succulent fodder to give large profits from our dairy herds and beef cattle. An analysis of the records concerning corn grown on the four Maritime Experimental Farms since each was organized shows only two failures. These occurred at Nappan and Fredericton in 1918. The same year the average yields at Kentville and Charlottetown were 13 tons and 14.4 tons per acre respectively.

The following table gives the average yield of corn per acre at each of these four Stations since their work with corn began:—

TABLE SHOWING AVERAGE YIELDS OF CORN AT THE FOUR MARITIME EXPERIMENTAL FARMS.

Farm or Station	Period of years	Average yield per acre	
		Tons	Lbs.
Kentville, N.S	1913–1922	14	572
Nappan, N.S	1892–1922	14	500
Charlottetown, P.E.I	1910–1922	13	1,940
Fredericton, N.B	1913–1922	11	785

Three poor years for corn were recorded during this thirteen-year period at Charlottetown. These unfavourable years were 1912, 1913, and 1919. The crows and blackbirds were partly responsible for the low returns. The lowest average yield at Charlottetown was $6\frac{2}{3}$ tons per acre; at Kentville, in 1915, their lowest yield was 9·4 tons per acre. On the other hand, every Station has had yields over 17 tons per acre and Nappan reports 23·1 tons in 1908.

Oats, peas and vetches are also grown as ensilage crops. The Agricultural College at Truro, N.S., reports heavy yields. The yields at Nappan and Fredericton in 1920 were 4·9 tons and 4·1 tons respectively. The ensilage from the combination of these forage plants is of much higher feeding value than from any other source recorded in Morrison and Henry's "Feeds and Feeding." It contains more than twice as much protein as corn or sunflowers.

Sunflowers have only been prominent as a silage crop for a few years in Eastern Canada. The Mammoth Russian variety produces a heavy tonnage of silage that is considered by many to be almost equal to corn. A three-year average yield of sunflowers at Nappan, N.S., was 22·8 tons and at Kentville, N.S., 16·16 tons per acre. The average yield of sunflowers for the past two years at Fredericton, N.B., was 14·9 tons and at Charlottetown, P.E.I., from the test of variety plots, was 14·58 tons per acre. When filling a silo, sunflowers do not bulk up like corn but pack closely and do not settle so much after filling.

The other fodder crops mentioned can be saved for hay or, should the weather be unfavourable for hay making, they can be quickly ensiled and make very valuable silage. Care must be taken to cut them fine, spread them evenly, tramp and pack them solidly and pour plenty of water into the cutting box during the process to insure against mouldy silage. Too much water, however, can be added to such crops when ensiling, resulting in bad odors and flavours.

SILAGE VS. ROOTS

Experimental feeding work has been carried on at Nappan, Kentville and Fredericton in feeding beef cattle with silage, comparing the results with those obtained when feeding roots.

At Kentville, during the winter of 1915-16, the twelve steers fed ensilage for succulent roughage made an average gain of 4¾ pounds each over the twelve fed roots. The ensilage was valued at $1 per ton more than the roots, yet the steers fed ensilage gave a little more profit than those fed roots. A pen of five steers fed roots and ensilage made better gains than those fed roots but less than those fed on ensilage without roots. In the winter of 1916-17 the results were still more favourable for the ensilage-fed steers. The profit they made over and above the profit of $22.23 made by those fed roots was 91 cents each.

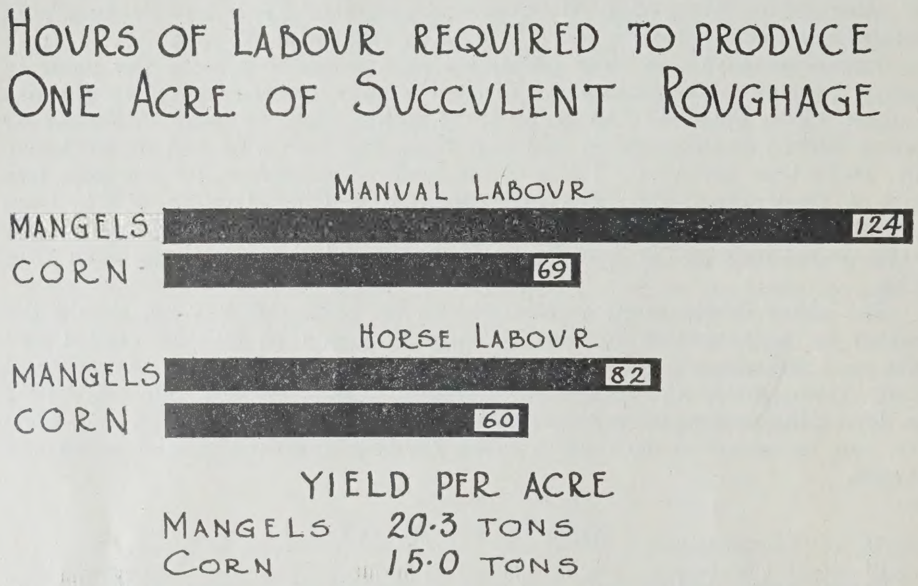
Steers fed at Nappan during the winter of 1916-17 gave results in favour of roots. The pen fed turnips made a gain of 173 pounds each, and the ensilage pen made a gain of 137½ pounds each, in the same period. The profit on those fed roots was $5.23 more than those fed ensilage.

During the same winter, steers fed ensilage at Fredericton made an average gain of 133 pounds; those fed roots a gain of 95·7 pounds. There a profit of $15.32 was obtained per steer from feeding ensilage over those fed on roots as a succulent roughage. The above data indicate that, year in year out, allowing for different methods of feeding, ensilage is valuable for fattening steers.

LABOUR REQUIRED FOR THE PRODUCTION OF SUCCULENT ROUGHAGES

The cost of production of farm crops is a very interesting subject. It may not always be possible to arrive at an accurate statement *re* the cost of farm products as there are so many items entering into farm problems that have to be estimated, but we can easily show the comparative amount of horse and manual labour required to produce crops.

A comparison of the labour required to produce an acre of succulent roughage from roots and from ensilage is graphically shown in the following table taken from the 1921 report of the Dominion Field Husbandman:—



The cost to produce turnips is practically the same as for mangels and for sunflowers as for corn.

VALUE OF ROUGHAGES

It is very difficult to place a fair value on roughages for feeding purposes. Three of the ways that they might be valued are: (*a*) succulent roughages might be valued according to the cost of production; (*b*) they might be valued at current market prices or (*c*) on a basis of dry matter content using some standard food as a basis of calculation.

(*a*) The following table gives the cost of production of roots and ensilage compiled from data taken from the Fredericton, N.B. Experimental Station Report for the year 1921:—

COST OF PRODUCTION OF SUCCULENT FODDERS AT FREDERICTON, 1921

Fodder	Yield Per Acre		Cost Per Acre	Cost Per Ton	Cost per ton Dry Matter
	Tons	Lbs.	$ c	$ c	$ c
Turnips	18	1,933	77 03	4 06	39 80
Corn	13	..	49 45	3 80	15 20
Sunflowers	12	775	57 90	4 68	19 75
Oats, peas and vetches	3	327	25 16	7 95	28 91

(*b*) Market prices vary so that they are a poor guide. The "Monthly Bulletin of Agricultural Statistics" for December, 1922, however, gives the following prices for hay and succulent fodders:—

Crops	Three Maritime Provinces. Average Price per ton for the years—		
	1920	1921	1922
	Per ton	Per ton	Per ton
Prince Edward Island.			
Hay and clover	$26 00	$30 00	$12 00
Turnips, etc	12 00	8 00	7 20
Fodder corn	10 00	6 00	6 00
Nova Scotia.			
Hay and clover	35 00	23 00	16 25
Turnips, etc	24 80	8 00	12 00
Fodder corn	10 00	6 00	9 50
New Brunswick.			
Hay and clover	27 87	25 00	14 00
Turnips, etc	8 00	6 80	15 60
Fodder corn	10 00	10 00	10 00
Average Three Maritime Provinces:			
Hay and clover	29 62	26 00	14 08
Turnips, etc	14 93	7 60	11 60
Fodder corn	10 00	7 33	8 50

(*c*) From data given in Henry & Morrison's "Feeds and Feeding," pages 240-242, we find that one ton of hay contains about 1,760 pounds of dry matter; corn silage about 500 pounds, swede turnips about 204 pounds, and mangels about 188 pounds of dry matter. Taking the average price of hay as given in the last table, the value of 100 pounds of dry matter from hay would be $1.68 in 1920, $1.47 in 1921, and 80 cents in 1922.

From "Feeds and Feeding" we find that dry matter from silage is worth about 11 per cent more than dry matter from hay and that dry matter from roots, though more digestible, has practically the same feeding value as that from silage. Taking these comparisons and using the value of hay as a basis, we find that the dry matter content of silage and roots would be worth, in the Maritime Provinces during 1920, $1.86; in 1921, $1.63; and, in 1922, 89 cents, per hundredweight. Using the price of hay, then, as a standard, the following table will give the average value of silage and roots as based on the dry matter content during the years mentioned for the three Maritime Provinces:—

AVERAGE VALUE OF ROOTS AND SILAGE, BASED ON DRY MATTER CONTENT, USING PRICE OF HAY AS STANDARD.

Crops	Year		
	1920	1921	1922
	Per ton	Per ton	Per ton
Turnips	$3 79	$3 32	$1 81
Silage	9 30	8 15	4 45

These figures conform fairly closely with those given in the former table for fodder corn but average $8.41 per ton below the figures given for roots by the Statistics Branch. There is no question that roots are a very valuable stock food. They contribute in no small way to the health of our animals and are believed by many feeders to add much to the digestibility of other foods fed. The above figures indicate, however, that the cost of obtaining dry matter for our stock from roots is very much greater than from silage.

SILO CONSTRUCTION

The walls and foundation are the essentials of any silo. If these are strong, straight, smooth, preferably circular, and air tight, it is a good silo.

Strong.—The walls must be strong enough to withstand heavy pressure from within when filled, and heavy wind strain from without when empty.

Straight.—The walls must be straight and true to insure even settling; any bulge or deviation from the plumb will either prevent the silage from settling or leave cavities of air where mould is sure to grow.

Smooth.—The inside walls must be smooth to allow the silage to settle readily. A smooth surface on the outside saves paint and presents a more resistant surface to the action of the elements.

Circular.—A circular silo will have the fewest crevices.

Air-tight.—The walls should be air-tight to promote correct fermentation and prevent mould.

To these essentials may be added a number of desirable factors in connection with economy of silage preservation.

Durability.—The silo walls and foundation should withstand the action of the elements, fire, frost and the acids freed by fermentation, to be permanent. Materials approaching these requirements are very desirable if the cost is not out of proportion to the service.

TYPES OF SILOS

There are many types of silos on the market to-day. Most of them conform to the essentials mentioned. A number of these types are referred to, since what will suit one farmer will not meet the requirements of another. Silos can be constructed from material secured and dressed locally or they may be ordered ready to erect from many manufacturing firms.

TYPES

The stave silo is easily and quickly erected. The material necessary is readily obtained anywhere in the Maritime Provinces. This type is popular on account of its cheapness and serviceability. There are many makes on the market; most of them are made with 2-inch staves. The more expensive are constructed of Douglas fir or red cedar. Any good spruce, either clear or stock with only sound knots, can be depended upon to make a satisfactory temporary structure that should last ten years or more.

The wooden hoop silo is constructed on hoops made by nailing together boards, three-eighths by four inches, so as to make circular hoops the size required. These hoops are hoisted into place, correctly spaced and held in place by scaffolding until the inside lining and the outside sheathing has been nailed to them, making walls about 5½ inches thick. Care must be taken to keep the lining and sheathing true and plumb. All lumber has to be carefully sized and must be even in thickness. This type, even if blown over by a storm when empty, will not collapse like a stave silo but can be quickly set in position again.

The concrete silo, with walls reinforced by half-inch iron rods or their equivalent, is one of the more permanent silo structures. The making or securing of the forms is one of the expensive items in the construction of a cement silo. A concrete silo should be built early in the spring so that it may be well set and hardened before filling. When well made it is a one-piece silo, with walls about 8 inches in thickness reinforced every 2 feet in height near the base and tapering to about 6 inches thick at the top.

The cement block silo is built with specially designed blocks of concrete provided with grooves for reinforcing wire and dovetailed together, making a thick symmetrical attractive wall.

The vitrified tile silo is reinforced with wire. Silos constructed of manufactured blocks of either cement or clay require skilled labour and are expensive equipment unless a number are being built in the same neighbourhood.

The pit silo is coming into general use in parts of Western Canada where soil conditions are favourable for construction. The soil should be firm enough to stand without caving. The walls are plastered, like a cistern, with three coats of concrete until air-tight. These silos built from 15 to 20 feet deep have proved economical and satisfactory where conditions are suitable.

When labour and material were relatively cheap, silos were constructed of boiler iron, of stone and of brick. When those constructed of boiler iron were kept well covered with a suitable paint they made a very efficient type of silo. Many of the first silos built were of stone. One of the chief objections to this type was the fact that the silage remained frozen to the walls much longer than it did to thin walls which warmed up much more readily in the spring. Where stone can be easily obtained it makes a splendid foundation and can be used to good advantage in constructing pit silos. Brick silos require reinforcing; the brick should be laid with cement mortar and the inside coated with a lining plaster of concrete. The brickwork is started with a three-course wall containing an air-space up to 20 feet in height above which two courses of brick make a strong wall.

These types of silos and others, some obsolete, all have their merits and objectionable features. The first cost of the more permanent types will prevent their being generally used until such time as silos are firmly established throughout the Maritime Provinces.

THE CHARLOTTETOWN EXPERIMENTAL STATION SILO

A silo was built at the Experimental Station at Charlottetown, P.E.I., during the summer of 1922. A careful investigation was made of the several different types, to determine which was most suitable for the neighbourhood. Quotations were secured from most of the Canadian manufacturers of ready-made stave silos. There are no silos being manufactured in the Maritime Provinces and the high freight rates on a single silo made them prohibitive at present. First quality spruce lumber was secured, dressed, grooved and tongued and beveled locally and a spaced-door type of stave silo 13 feet by 20 feet was erected. It was built on a temporary site six feet from the barn and about north from the centre of it. It was expected that it would be removed in a year or so to the Blake property just acquired, where it would be placed on a concrete wall that would increase its height to about 28 feet.

The foundation used was a large concrete hog feeding floor 20 feet by 20 feet with a 6-foot square additional area for passing feed over in or out from the barn. This small square was directly under the chute and saved wastage of silage when it was thrown down and passed in through a barn window to the feed alley midway in front of the dairy cattle. The feeding floor contained more than twice the area in square feet required for a base for the silo even when a 12-inch footing was allowed around outside of the staves. The cost of building this foundation is given though it is more than the cost of a proper foundation for a silo.

The site was excavated to solid earth and filled with broken stone, well pointed in, as a base for the covering of about one foot of cement for the foundation. The concrete mixture was cement 1 part, coarse sand $2\frac{1}{2}$ parts and water-washed gravel 4 parts, by measure.

The following statement of actual costs is given for the information of those who plan to build a silo with their own labour and lumber:—

COST OF ERECTING STAVE SILO 13 FEET BY 20 FEET AT CHARLOTTETOWN, P.E.I., 1922.

BILL OF LUMBER, HARDWARE SUPPLIES AND LABOUR REQUIRED.

Foundation.—		
15 bags cement at \$1.25	\$18 75	
2 loads sand at \$1.00	2 00	
$2\frac{1}{2}$ tons gravel at \$3.25	8 13	
Labour excavating, 20 hours at $26\frac{1}{2}$ cts	5 30	
Labour mixing and laying concrete 40 hours at $26\frac{1}{2}$ cts	10 60	
Cost of foundation		\$44 78
Lumber.—		
72 spruce staves 2″ x 6″ x 20′ = 1,643 ft. at \$50	\$82 15	
Sides and Cross pieces of doors, 74 ft. at \$50	3 70	
50 ft. R.M. 2″ x 4″ rafters at \$25	1 25	
52 ft. R.M. 2″ x 2″ studding chute at \$14	0 73	
500 ft. B.M. $\frac{7}{8}$ sheathing chute V roof at \$35	17 50	
Milling and dressing lumber	13 85	
		\$119 18
Hardware.—		
594 lb. iron rods at $2\frac{1}{2}$ cts	\$20 79	
Rolling hoops to shape	5 40	
Threading rods, nuts and washers	8 05	
4 gallons Everjet tar paint at \$1.00	4 00	
2 gallons gray barn paint at \$1.75	3 50	
42 turnbuckles at 25 cts	10 50	
14 lb. nails at 7 cts	0 98	
6 lb spikes at $6\frac{1}{2}$ cts	0 39	
Bolts and washers for doors	0 45	
		\$54 06
Labour—		
Erecting staves 40 hours at $33\frac{1}{2}$ cents	\$ 13 40	
Putting on hoops, 15 hours at 40 cents	6 00	
Putting on roof, 26 hours at 40 cents	10 40	
Building chute, $17\frac{1}{2}$ hours at 40 cents	7 00	
Painting-two coats inside and out at 30 cents	6 00	
		42 80
		\$ 260 82

The cash outlay to a farmer who has his own lumber and labour would therefore be about \$97.00 as follows:—

Material for foundation	\$ 28 88
Milling and dressing lumber	13 85
Hardware supplies	54 06
	\$ 96 79

BUILDING THE SILO

After excavating to solid earth and filling with broken stone, a form made of rough boards was set up and well braced to the desired height. (Fig. 1.)

FIG. 1.—Form Ready for Cement

A good mixing board was drawn close and the cement, sand and gravel placed conveniently. Two men mixed the 2-bag batches, one wheeled the mixed concrete to the site with a wheelbarrow and another leveled and tamped it, the labourers regularly employed at the Farm doing the work. The surface was finished with a batch mixed 1 part cement to 2 parts sand. This strong mixture was also worked down with a spade around the sides of the form. (Fig. 2.)

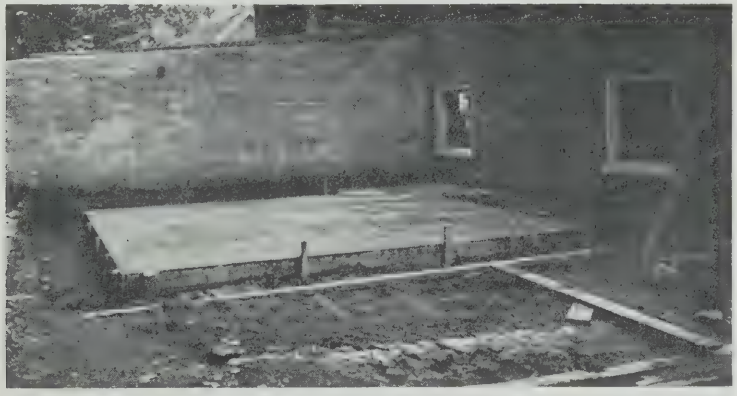


FIG. 2.—Foundation Complete

As soon as the concrete was set hard, scaffolding was set up around a circle drawn by driving two spikes through a batten, so that one was sent into the concrete in the centre of the silo site and the other just through the batten $6\frac{1}{2}$ feet from the other. When this one was moved around, scratching the surface of the concrete, it made the circle for the silo 13 feet in diameter. This spike

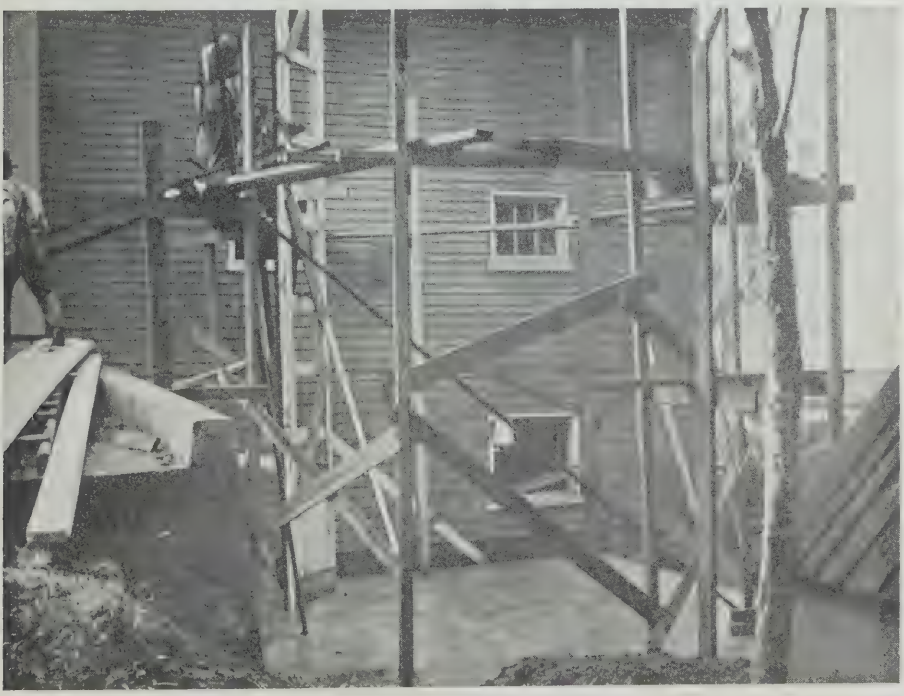


FIG. 3.—Setting Up Door Frame

was withdrawn and driven through the batten again 2 inches farther from the centre and, when moved around again, it marked a line for the outside of the staves.

The door frame was constructed of 2-inch by 6-inch spruce pieces with a one-inch rabbet on the inside. This extended all around for the doors to fit into. The outside edges of the door frame planks were grooved and tongued to

Fig. 4.—Setting Up First Staves

fit the staves. The staves were all spruce 20 feet long, milled all around and grooved and tongued. The door frame was set in place and securely braced. (Fig. 3.)

Two men quickly set the staves up and drove the groove and tongue together. (Fig. 4.)

One man working on the scaffold, the other working on the floor toe-nailed each stave in place into the concrete and to the previous stave. (Fig. 5.)

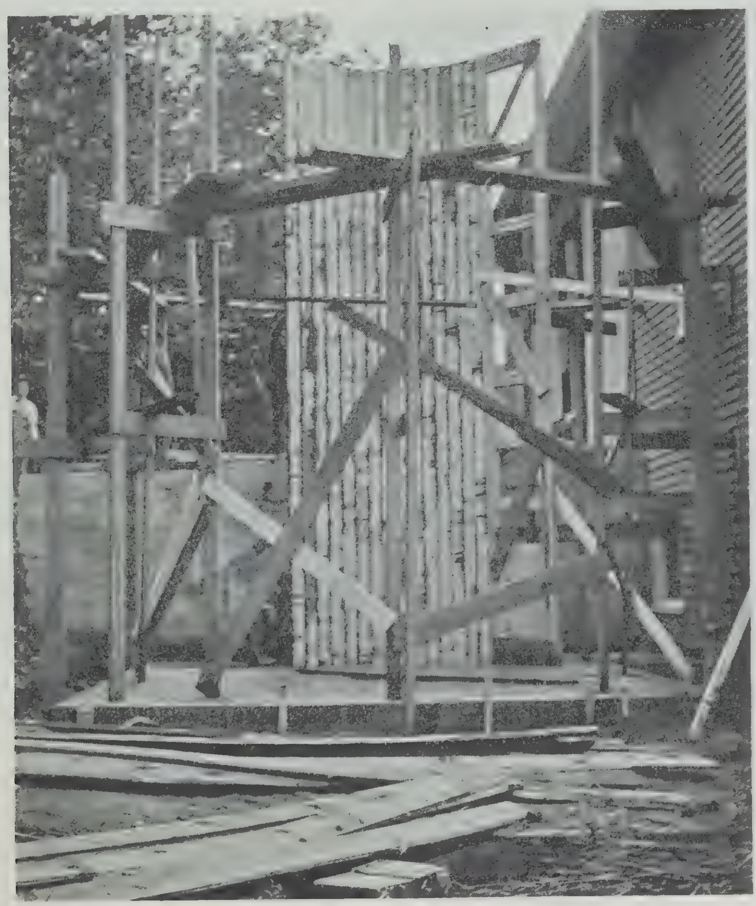


Fig. 5.—Toe-nailing Staves

Before putting the staves together they were given a heavy coat, on both edges, of Everjet Tar paint, well rubbed in with a brush. (Fig. 6.)

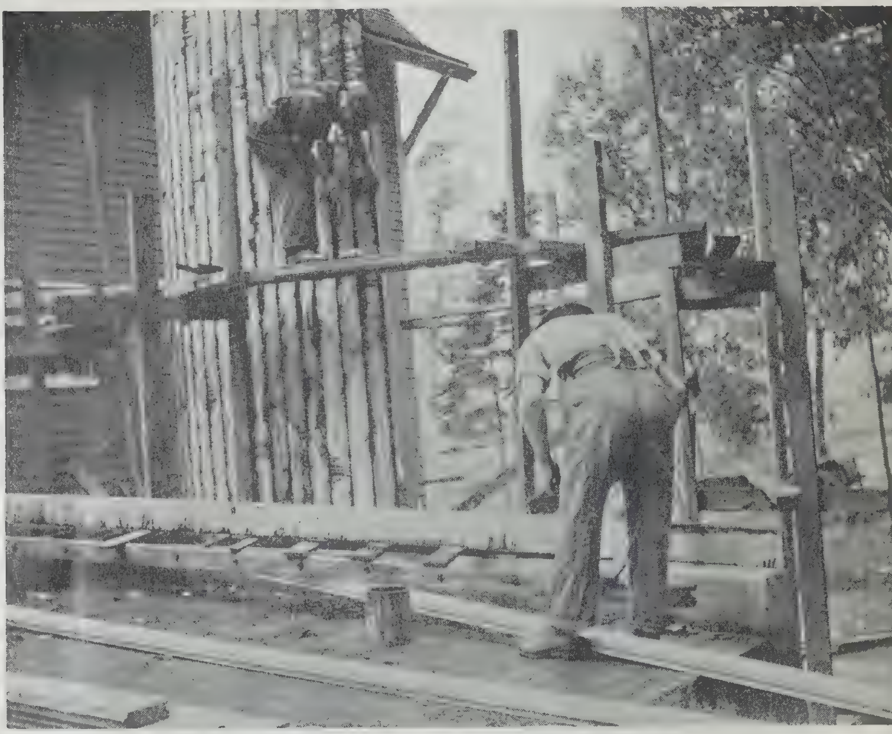


Fig. 6.—Coating Edges of Staves with Everjet Tar

The staves were bevelled so that they formed the circle. (Fig. 7.)

Fig. 7.—When Half of the Staves Were Up

The staves were braced to the scaffold and the silo quickly closed in. (Fig. 8.)

FIG. 8.—Only a Few Staves More

The men then trued all the staves up as soon as the last one was in place. (Fig. 9.)

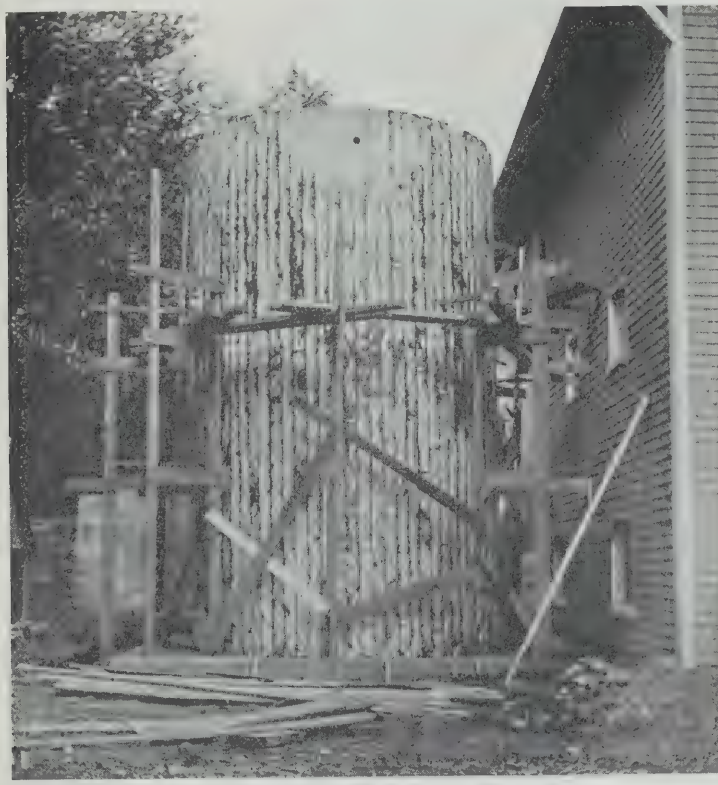


Fig. 9.—Trueing the Staves

The hoops were of $\frac{3}{4}$-inch iron, in three sections and rolled to the shape of the silo. A turnbuckle was placed between each section, the nuts on the ends of the rods tightened and the first hoop was drawn into place. Spikes were driven to hold the hoops in place around the silo until each hoop was tightened. The second hoop was put in place. (Fig. 10.)

Fig. 10.—Placing Second Hoop

The ten hoops were properly spaced and tightened up. (Fig. 11.)

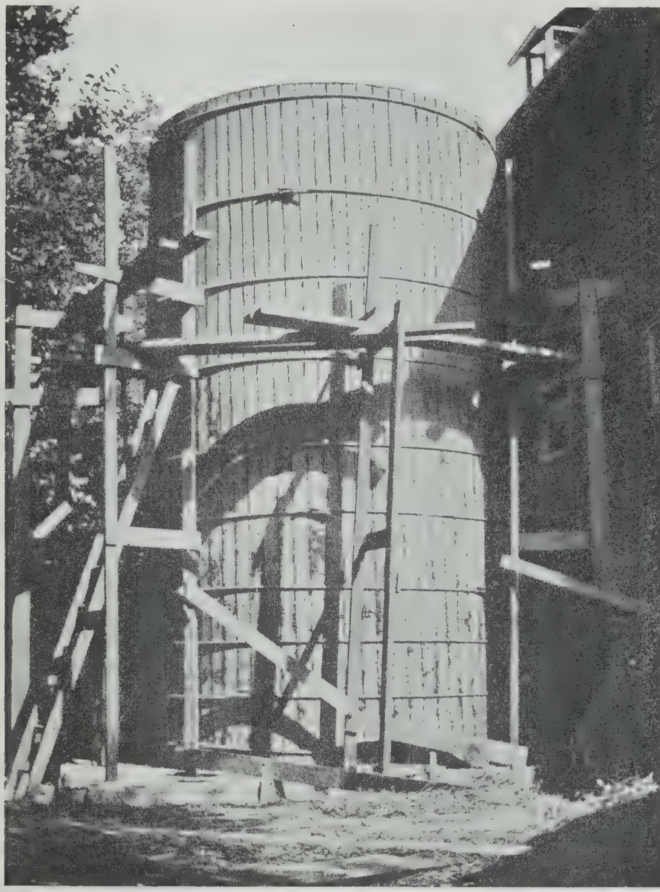


Fig. 11.—Ten Hoops in Place

The silo was then given one coat of grey paint and the scaffold taken away. Shortly afterwards, when the tar paint had dried on the inside, some early sunflowers were cut with an ensilage cutter and blown in. (Fig. 12.)

FIG. 12.—Silo Ready for Filling

Sunflowers require careful feeding to keep the heads from catching. (Fig. 13.)

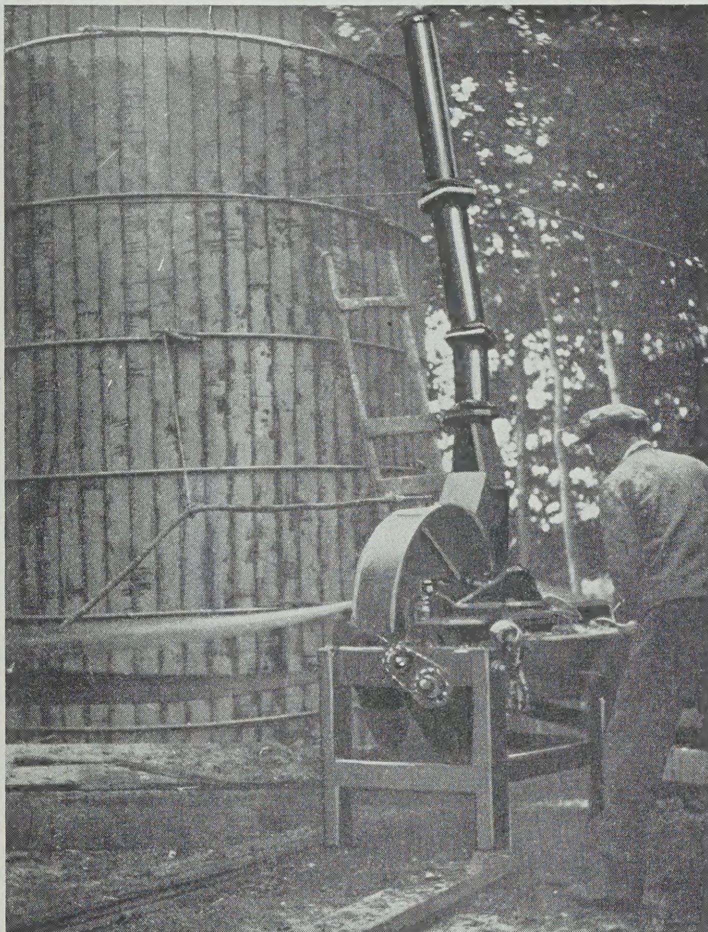


Fig. 13.—Filling with Sunflowers

When the silo had been filled, the men working from the top of the silage put a dome top on. The rafters were two inches by four inches spruce lumber, spiked to the top of the staves. The grooved and tongued sheathing was cut with as little waste as possible and nailed on the rafters. A door was cut on the side next the driveway for future filling. The roof was completed. (Fig. 14.)

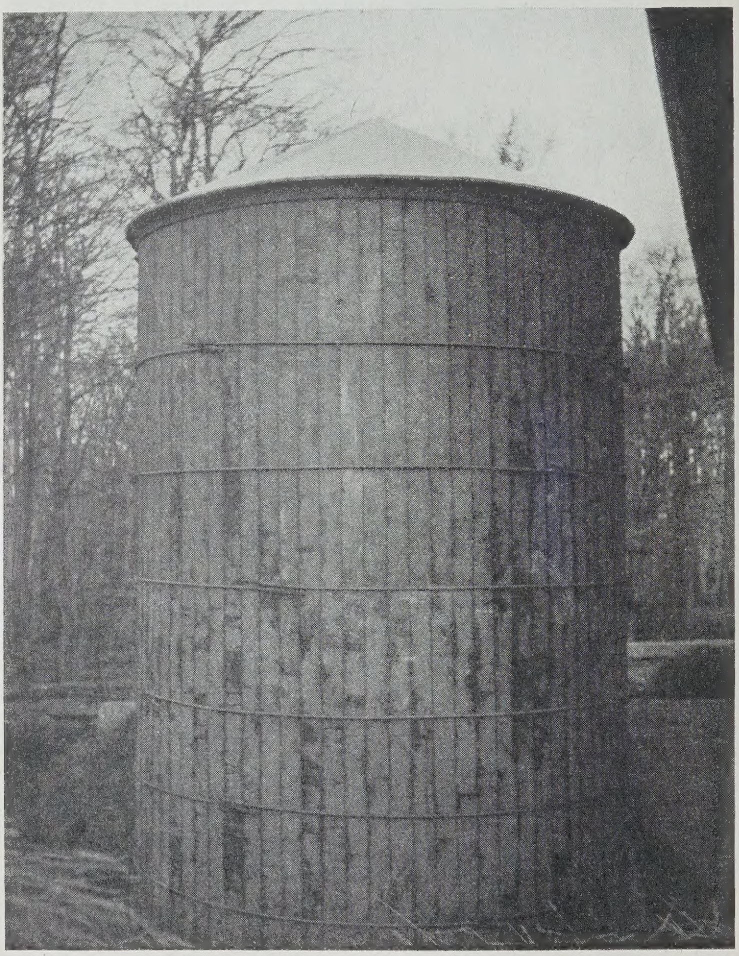


FIG. 14.—Roof Built of Seven-eighth Sheathing

A chute was constructed over the doorways with a frame two-inch by two-inch spruce covered with sheathing. (Fig. 15.)

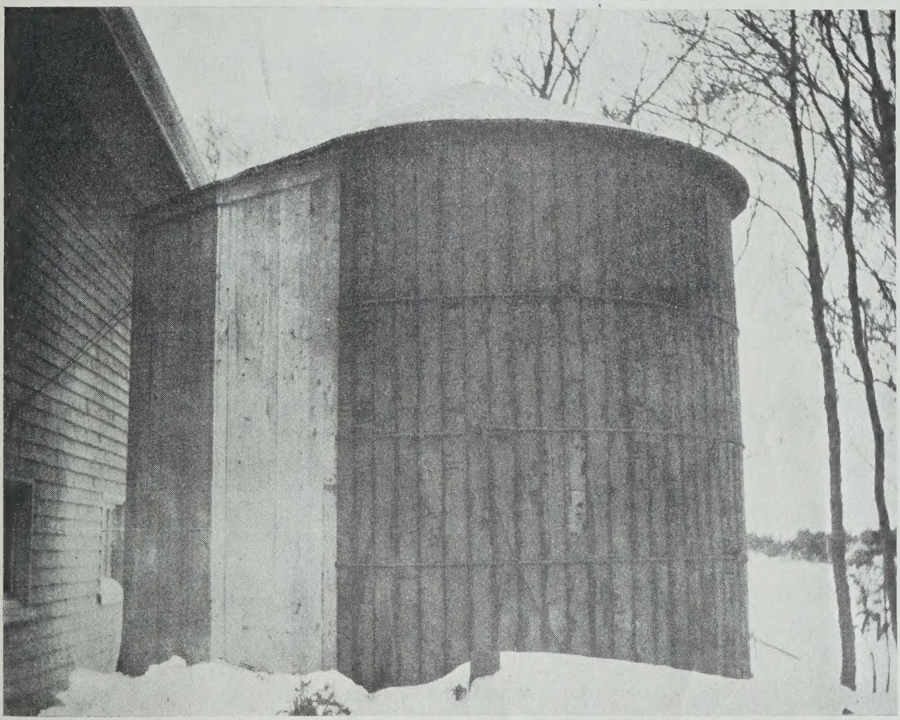


Fig. 15.—Chute over Doorways

A shed roof was built over a window from the barn to the chute to protect the silage, when thrown down, from the weather. (Fig. 16.)

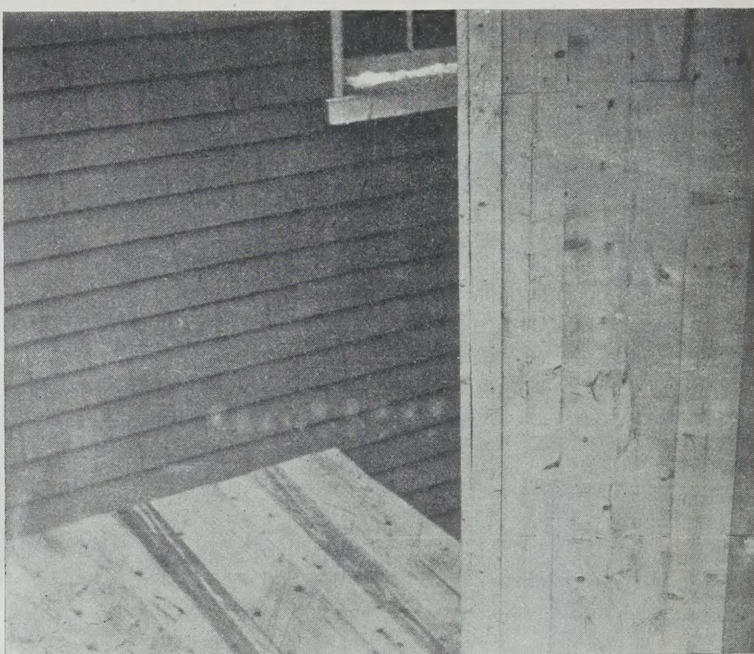


FIG. 16.—Shed Roof to Barn from Chute

The entire work on the silo was done by farm hands, the work of the foreman and herdsman being charged at the rate of 45 cents per hour, the present rate of a foreman carpenter. The wages of the labouring men were averaged at cost. In this way the erecting of the staves cost $33\frac{1}{2}$ cents per hour, the other carpenter work averaging 40 cents per hour. The painting was charged at cost, 30 cents per hour.

The silo was opened the first of the new year. There were about three inches of waste on top; below that the silage was first-class in quality.

A stave silo built by farm labour from lumber secured locally can be erected at small cost and will pay for itself many times over in a few years by supplying an abundance of succulent roughage, so necessary in the economical production of milk and beef.